

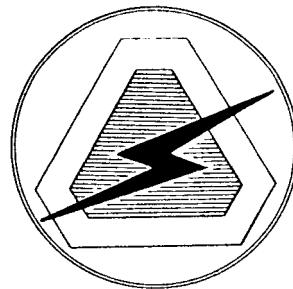
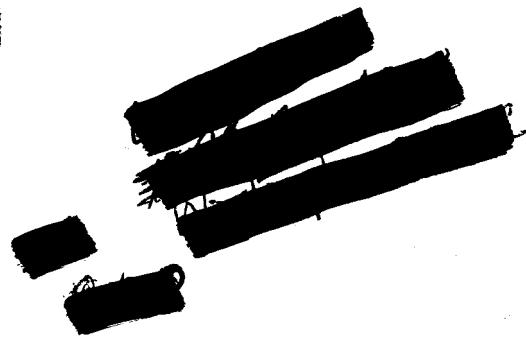
CONFIDENTIAL

ARMY review
completed.

EVALUATION REPORT ON MCN - 17911

SOVIET REMOTE - READING METEOROLOGICAL STATION

TYPE DMS - N-53



2-3 E 043

DOWNGRADED AT 12 YEAR INTERVALS
NOT AUTOMATICALLY DECLASSIFIED
DOD DIR 5200.10

Army-Ft Monmouth, NJ-MO-5240-62

**UNITED STATES ARMY
ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY
FORT MONMOUTH, N.J.**

Ind 26

CONFIDENTIAL

CONFIDENTIAL

EVALUATION REPORT ON RUSS - 17911

SOVIET RADAR - READING METEOROLOGICAL SATION

TYPE RUSS - R-53

DOWNGRADED AT 10 YEAR INTERVAL
NOT AUTOMATICALLY DOWNGRADED
DOC 2000-03-20

CONFIDENTIAL

EVALUATION OF MCH 17911

DATE

INTRODUCTION

MCH 17911 is a Soviet, Remote-Reading Meteorological Station, Type INS-4-53, manufactured by the Soviet Hydromet Pribor factory in Leningrad, USSR, in 1959. It is designed to measure air temperature, humidity, and wind speed and direction, with remote indicators that can be placed up to 165 feet from the sensors.

The equipment is sturdily built, evidently to withstand the repeated assembling and disassembling required of portable equipment.

The wind-speed and wind-direction assembly is designed to stand vertically on a rod-type support, assumed to be a tripod, which is not provided with the equipment. The temperature and humidity assembly mounts in a radiation shelter that is connected to the main axis by a support arm. The whole equipment, though heavy, is easily assembled, and can be quickly put into service. The attached photograph shows the equipment assembled on an American-made tripod (from Wind Equipment Al/GM-12), along with the indicator unit, cables, and carrying box. The missing space on the indicator panel had been occupied by a hand-wound clock that was stolen. Everything except the cables and reel is carried in the carrying box. A tool kit and a few spare parts are

~~CONFIDENTIAL~~

kept in a separate container in the carrying box.

DISCUSSION

Physical Characteristics

1. Dimensions:

Anemometer cup: 5" diameter, 7" from center to main axis

Wind vane: 9" x 9" x 2-1/4" maximum thickness; 19" from tip to main axis.

Wind-speed-and-direction assembly: 24-1/2" tall (w/o tripod)

Thermal shelter: 15-1/2" high x 8-1/2" diameter

Support arm for shelter: 19-1/4" long, shelter to main axis

Indicator unit: 15" x 7" x 9" high

Carrying box: 27" x 17-1/2" x 17-1/2" high

Cables: Two each, 165' long; reel, 16" diameter, 14-1/2" high

2. Weights:

Anemometer cup assembly: (251 grams) .55 lb.

Wind vane: (369 grams) 1-1/4 lb.

Counter weight for wind vane (761 grams) 1-3/4 lb.

Wind vane bearing unit (530 grams) 1-1/6 lb.

Total, Wind Direction Unit: (1860 grams) 4-1/6 lb.

Wind-speed-and-direction assembly, complete 12.6 lb.

Radiation shelter and support arm, with temperature and humidity units 12.4

Indicator unit, with battery 19.0

Carrying box and spare parts 43.5

Cables and reel 52.5

Total 140.0 lb.

~~CONFIDENTIAL~~

CONFIDENTIAL**PRINCIPLES OF OPERATION**

The Soviet Remote-Reading Meteorological Station, Type DMS-II-53 operates on 28 volts d.c., either from a battery or an a.c. supply. Two 165 foot cables are supplied to the indicator unit, one from the wind-speed and direction assembly, and one from the temperature - humidity unit in the radiation shelter.

Wind Speed: Wind speed is indicated on the meter in meters per second on a scale from 0 to 30 meters per second. The meter must be switched to the wind speed position. The anemometer is a 3 - cup type, made of a very light metal, supported on the same axis as, and about 9 inches above, the wind vane. The anemometer cup unit is very light for its size, and it rotates smoothly and easily on the supporting shaft, which is supported by a small ball-bearing. The shaft turns the armature of a generator, the a.c. signal from which is converted to a direct current in the indicator unit. A calibration chart accompanying the equipment shows a comparison of wind speed against what must be rate of pulses from the generator. A rough check by the evaluation of wind speed versus revolution speed of the anemometer gives a value of 4.0 meters per second equals 1.5 revolutions per second. The generator was observed to produce three cycles of alternations for each revolution of the anemometer. If each cycle produces two pulses for counting purposes, the result gives the order of magnitude of values given on the calibration chart. The graph on this chart indicates a minimum wind speed of .033 meters per second at zero pulses per second. This minimum speed, equal to .033 miles per hour, is one decimal order of magnitude lower than that of American equipments of this type. The top

CONFIDENTIAL

CONFIDENTIAL

speed on the chart is 2.0 meters per second, whereas the top speed on the meter scale is 30 meters per second.

Wind Direction: Wind direction is indicated continuously on a separate 36 point dial with the smallest division equal to two degrees. It is activated by a fast-responding d.c. synchro in the indicator unit. A pointer on the main axis enables alignment with a known direction. The wind vane with its counterweight, in contrast to the anemometer, is heavy and has large inertia. It is supported in the main axis by two large ball-bearings. The electrical connections are made through three wiper arms, two of which contact slip-rings and the third of which contacts a potentiometer. The possible explanation for the heavy design of the wind vane is that it smoothes out rapid fluctuations in wind direction so that an operator can obtain a usable and meaningful reading. Since this is not a recording instrument, details of fluctuations could hardly be useful.

Temperature: Temperature is indicated on the meter, when switched to that position, in degrees centigrade, and is measured by a wire-wound resistance thermometer of about 200 ohms, mounted inside the radiation shelter. This resistance is encased in a hollow cylinder 2 1/2 inches long, 0.8 inches outer diameter, with a wall thickness of 0.07 inch, and with the outer surfaces chrome plated. The current through the resistance gives a measure of the value of the resistance, after the voltage source is adjusted by switching to "calibrate" position and adjusting the "adjust" knob so the meter reads on the calibration mark. The scale on the meter goes from -49°C to +49°C.

CONFIDENTIAL

Relative Humidity: Humidity is indicated on the meter, when switched to that position, in percent, from 20 to 100. It is measured by the current flowing through a potentiometer inside the radiation shelter, whose wiper arm is activated by the extension and contraction of a set of hygrometer hairs. The arrangement of hairs is similar to that used in American hygrothermographs. They are about nine inches long, with about five hairs per strand, and a total of six strands. The whole unit is mounted in a perforated chrome-plated tube. A separate linkage attached to the hairs moves a pointer across a scale from 20 to 100 that is visible through a window when the top part of the shelter is removed. When the switch on the indicator unit is placed in the "humidity" position, a relay in the shelter activates a clamp that causes the wiper arm to contact the potentiometer and holds it there. The reading on the indicator is valid if the voltage source is first adjusted as described for the temperature reading. A spare set of hairs is contained in the tool box.

The radiation shelter consists of a stacked array of spaced, truncated cones, resembling a pagoda, painted white enamel. Direct sunlight is prevented from reaching the temperature and humidity sensors, and air is permitted to ventilate freely over them. The elements are further protected, probably from insects, by encasement within a wire screen mounted inside the shelter. No provision is made for forced ventilation.

TEST PROCEDURE

The DME-H-53 equipment was compared first with standard U. S. Army equipment used at weather stations, under equal exposures of sensors, during more than twenty days over a period of more than two months. Then

CONFIDENTIAL

the wind sensors were compared with the U. S. Army Wind Measuring Set AK/GMC-12, made by Beckman and Shiley, under equal exposures during eight days.

In the first test the equipments were placed on a platform that was ten feet above the ground, and some of the indicators were kept in a building about 50 feet away. Wind speed and wind direction comparisons were made with the U. S. Army Wind Measuring Set AK/GMC-11. Temperature comparisons were made with the U. S. Army Recording Hygrothermograph, Model 554, made by Fries Instrument Division, The Bendix Corporation, and with a standard mercury thermometer. Relative humidity comparisons were made with the same hygrothermograph and with U. S. Army Psychrometer AL-24. Of the American equipment only wind speed and wind direction indicators were kept inside the building. Temperature and humidity readings on the American equipment had to be taken on the platform, since these instruments have no remote indicators.

The observations were extended through more than two months in order to obtain a large variety of weather conditions, so that a broad comparison could be made. The observations were performed and recorded at 1/2 hour intervals during the daytime by trained U. S. Army Signal Corps military weather observers.

On the second test the wind sensors were placed on a platform that was eight feet above the ground, and the indicators were kept sheltered on the ground about 15 feet away. Wind speed and wind direction comparisons were made with U. S. Army Wind Measuring Set AK/GMC-12. Again the observations

CONFIDENTIAL

were performed and recorded at 1/2 hour intervals during the daytime by trained U. S. Army Signal Corps military weather observers.

RESULTS

The quality of the results are possibly tempered by the condition of the DME-N-53 equipment. On receipt of the equipment, several components were found to have broken loose from their wooden supports in the carrying boxes. One of the anemometer cups was slightly dented, and two protective collars on the main axis were dented; but these defects did not affect operation of the equipment. The thermometer cylinder had broken loose from its cement seating, and one electrical lead was broken. Resoldering of the lead [redacted] was successful, but with a resistance of only 200 ohms for the temperature element, a small calibration error may have been introduced. The hygrometer hair assembly was not cleaned upon receipt, even though it had been in the equipment for well over a year. However, the comparison equipment, the Hygrothermograph, was not cleaned either, and it probably had a comparable history of contamination.

Wind Speed: In comparison with the AN/URG-11 over a period of 22 days, 139 readings were taken. In every case but four the DME-N-53 read higher. A source of systematic error was looked for but not found. Since several different observers were used, and for different periods of time, human error was ruled out. Consistent error was suspected in converting the readings of the American AN/URG-11 from knots to meters per second, but the errors were not proportional to the wind speed as they would have to be.

CONFIDENTIAL

CONFIDENTIAL

Results are tabulated below:

(MEAN DIFFERENCE) readings :	+ 2.4 meter per second
Maximum difference :	+ 5.6 meters per second (single isolated case)
Next to maximum difference :	+ 4.7 meters per second
Maximum wind speed (AN/URG-11) :	10.3 meters per second
Minimum wind speed :	0 meters per second
Standard deviation from the average :	1.0 meters per second

The distribution of differences in wind speed readings was non-normal, so no statement can be made based on statistics of a normal distribution. However, a relation developed by Chebyshev for non-normal distributions can be used. This states that the ~~area~~ of area under any distribution curve which is further away from the mean than $\frac{1}{\sigma}$ is less than $\frac{1}{k^2}$, where σ is the standard deviation. He further showed that for a symmetrical distribution with a single mode the ~~maximum~~ area further than $\frac{1}{\sigma}$ from the mean is $\frac{1}{4}$. This second relation shows that 89% of the values would lie within $\pm 2 \sigma$ of the mean value.

Since a graph of the wind speed difference data shows a reasonably symmetrical distribution about the mean, Chebyshev's second relation is used to determine that 89% of the wind speed differences could be expected to fall within ± 2.0 meters per second of the mean difference, + 2.4 meters per second, or between + .4 and + 4.8 meters per second.

Wind direction: In comparison with the AN/URG-11 over a period of 22 days, 170 readings were taken, covering 14 of the 16 compass points (excluding only NE and SE). The two equipments agree exactly on all

CONFIDENTIAL

CONFIDENTIAL

readings when recorded to the nearest compass point.

Wind Speed: In comparison with the AN/SMQ-12 over a period of 8 days, 41 readings were taken. The differences were both positive and negative in a sufficiently random fashion to conclude an absence of systematic error.

Results are tabulated below:

Average difference in reading :	- .18 meters per second (Soviet minus American)	- .18 meters per second
Maximum difference :	+ 1.4 meters per second (single isolated value)	+ 1.4 meters per second (single isolated value)
Exit to maximum difference :	- 1.2 meters per second	- 1.2 meters per second
Maximum wind speed (AN/SMQ-12) :	6.2 meters per second	6.2 meters per second
Minimum wind speed :	0 meters per second	0 meters per second
Standard deviation from the average :	.47 meters per second	.47 meters per second

Since a graph of the wind speed difference data shows a reasonably symmetrical distribution about the mean, Chebyshev's second relation is used to determine that 89% of the wind speed differences could be expected to fall within $\pm .94$ meters per second of the mean difference, - .18 meters per second, or between - 1.12 and + .76 meters per second.

Wind Direction: In comparison with the AN/SMQ-12 over a period of 8 days, 41 readings were taken, covering all 16 compass points. The two equipments agree on all but 7 readings, when recorded to the nearest compass point. Those 7 readings differ by only one compass point.

Response of Anemometer: In a crude test of response of the anemometer, performed indoors by subjecting them to a steady wind from a large fan, by opening/door suddenly, the Soviet unit reached a steady reading in an average of 3 seconds; the AN/SMQ-12 in 1.5 seconds. In another test,

CONFIDENTIAL

CONFIDENTIAL

by holding the unit in a steady wind, then releasing it suddenly, the Soviet unit reached a steady reading in an average of 2.5 seconds; the AG/PM-12 in a time too short to measure reliably with a stop watch.

Temperature: In comparison with an American mercury thermometer over a period of 23 days, 167 readings were taken. In every case but one the DGS-N-53 read lower. The mercury thermometer was protected from radiation by being in a weather shelter, which should have given it exposure comparable to that of the Soviet unit.

Results are tabulated below:

Average difference in readings (Soviet minus American)	+ 1.2°C
Maximum difference	+ 3.1°C
Maximum temperature (mercury thermometer)	+ 43.3°C
Minimum temperature	+ 3.3°C
Standard deviation from the average	.06

Assuming a symmetrical distribution, as shown by a graphic plot, Chebyshev's second relation shows that 95% of the differences could be expected to fall within $\pm 1.2\sigma$ of the mean difference, + 1.4°C, or between 0 and + 2.4°C.

In comparison with the American hygrometerograph over a period of 12 days, 163 readings were taken. The hygrometerograph was also in the weather shelter, and hence should have exposure comparable to that of the Soviet unit.

Results are tabulated below:

CONFIDENTIAL

CONFIDENTIAL

Average difference in readings (Soviet minus American)	: - .67°C
Maximum difference	: + 3.1°C (single isolated value)
Maximum temperature (Pyrothermograph)	: + 71.9°C
Next to maximum Difference	: - 2.6°C
Minimum temperature	: + 5.0°C
Standard deviation from the average	: .80°C

Assuming a symmetrical distribution, as shown by a graphic plot, Chebychev's second relation shows that 89% of the differences could be expected to fall within $\pm 1.60^\circ\text{C}$ of the mean difference, $- .67^\circ\text{C}$, or between $- 2.27^\circ\text{C}$ and $+ .93^\circ\text{C}$.

Since the data for the comparisons of the IMI-N-53 with the mercury thermometer and with the Pyrothermograph were taken at the same time, it is useful to compare the mercury thermometer with the Pyrothermograph. Over a period of 22 days, 183 readings were taken. Most of the mercury readings were higher.

Results are tabulated below:

Average difference in temperature (mercury minus Pyrothermograph)	: + .53°C
Maximum difference	: - 1.5°C
Maximum temperature	: + 60.3°C (mercury)
Minimum temperature	: + 5.0°C (Pyrothermograph)
Standard deviation from the average	: .68°C

Assuming a symmetrical distribution, Chebychev's second relation shows that 89% of the differences could be expected to fall within

CONFIDENTIAL

CONFIDENTIAL

$\pm 1.3^{\circ}\text{C}$ of the mean difference, $+ .03^{\circ}\text{C}$, or between $- .83^{\circ}\text{C}$ and $+ 1.3^{\circ}\text{C}$.

Considering great differences in design of these types of thermometers and the inherent inaccuracy of the Hygrothermograph, these results show good agreement.

Humidity: In comparison with the U. S. Army Psychrometer NL-24 and with the U. S. Army Hygrothermograph in 183 readings over a period of 22 days, the Soviet IAS-II-53 humidity element gave readings greatly different from those of the U. S. Instruments, and always below them except for a few readings at humidities below 30% R.H. The Soviet readings were seldom within 10% R.H. of the U. S. readings, and at high humidities, 80 to 100% R.H., were 20 to 30% R.H. below the U. S. readings. Even at humidities below 30% R.H., the Soviet readings differed by 5 to 8% R.H.

No statistical comparison was made between the Soviet equipment and the two U. S. equipments because of the large differences. But, in order to establish the validity of the U. S. readings, a comparison was made between the two U. S. equipments. Over a period of 22 days 183 readings were taken. Results are tabulated below:

Average difference in reading (Psychrometer minus Hygrothermograph)	: $- .33\%$ R.H.
Maximum differences	: $- 18\%$ and $+ 16\%$ R.H.
Minimum difference	: 0% R.H.
Maximum Humidity (both units)	: 100% R.H.
Minimum Humidity (Psychrometer)	: 20% R.H.
Standard deviation from the average	: 5.3% R.H.

CONFIDENTIAL

CONFIDENTIAL

Assuming a symmetrical distribution about the mean, Chistyakov's second relation shows that 89% of the differences could be expected to fall within $\pm 11.1\%$ R.H. of the mean difference, $- .3\%$ R.H., or between -11.4% and $+10.8\%$ R.H. These figures show a reasonable agreement between the Psychrometer and the Hygrothermograph, much greater than with the Soviet unit. It is possible that the previous history of the Soviet Psychrometer hair assembly impaired its performance, either through damage or contamination.

COMPARISON

The Soviet Remote-Reading Meteorological Station, Type DNG-N-53 is a well-built equipment, constructed of strong components, and designed to perform a specific function as a portable equipment. But it offers nothing new in the techniques of measuring meteorological parameters. Its heavy sturdiness makes it durable under field handling, but increases the problems of carrying it when packed. Its components are designed to enable easy and quick assembly and disassembly. The absence of provision for measurement of barometric pressure distinguishes it from most U. S. equipment, and probably indicates that it was designed for a particular use.

The resistance temperature element of the DNG-N-53 is similar to the wire-wound U. S. "Thermocels", but probably is faster in response since it is wound on a hollow cylinder. Wire-wound resistance type temperature elements can be constructed for very accurate temperature

CONFIDENTIAL

CONFIDENTIAL

measurement, but errors can be introduced through (a) use of ohm-meter type measurement instead of Wheatstone bridge, (b) radiation exchange to the large exposed surface (in spite of being sheltered), and (c) slowness of response of the large mass. A good mercury thermometer, such as is used in the U. S. Army Manual Meteorological Stations AN/PKG-1 and AN/PKG-4, can be just as reliable, but of course cannot be read remotely very easily. Techniques of temperature measurement with a thermistor, or even with a thermocouple, can give reliable, rapid-responding readings perhaps better than this wire-wound resistance element, and can be used with a remote indicator.

The hair hygrometer type of humidity element in the MSG-4-13 is not in general use in portable U. S. equipment, but the Hygrotherograph Model 35A does use it. The Soviet hair assembly is very similar in size and construction to the U. S. unit. The ventilated psychrometer, such as the sling type, M-38, used in Meteorological Station AN/PKG-4, and the motor-aspirated type, M-55 used in Meteorological station AN/PKG-1, are more reliable than the hair hygrometer and are preferred. But again, these psychrometers require manual operation and cannot give remote indications.

The large cup - type anemometer and heavy wind vane used in the MSG-4-13 are not in general use in portable U. S. Army equipment. The Wind Measuring Set AN/DMC-12 is the U. S. standard. It is much lighter, much smaller, more sensitive, and faster responding. Its cup assembly weighs only 11 grams, and measures 3 1/2 inches in rotational radius, compared to 51 grams and 9 1/2 inches for the Soviet unit. The U. S.

CONFIDENTIAL

CONFIDENTIAL

wind vane weighs only 60 grams and measures 3 inches high by 6 1/2 inches in rotational radius, compared to 1000 grams and 9 inches high x 9 inches for the Soviet unit. The fast response and high sensitivity are desirable when the information is recorded on a strip chart, as the AN/CRG-12 is. Without the chart record for post - analysis, rapid fluctuations in wind speed and direction not only can't be used but can make it difficult to obtain a sensible reading on an indicator. It may be for this reason that the Soviet unit has been so greatly lagged, in order to allow an average reading to be taken. The starting speed of the Soviet anemometer, about 2 meters per second or 4.5 miles per hour, is considerably higher than the U. S. unit, about 3/4 mile per hour (1/3 meter per second). The calibration chart furnished with the Soviet equipment gives a minimum speed of .030 meters per second. This speed could hardly be achieved by an operational unit, and is an order of magnitude below the readability of the indicator, so it is not understood what the calibration means.

The U. S. Wind Measuring Set AN/CRG-11 is more nearly comparable to the Soviet equipment, in size, weight, response and function, having similar remote indicators.

C O N C L U S I O N

The Soviet Remote-Reading Meteorological Station, Type (MS-2-3) is a heavy, sturdily built portable equipment that measures temperature, relative humidity, wind speed, and wind direction, and gives remote indications of these measurements up to 160 feet (the limit of cable length). No U. S.

CONFIDENTIAL

CONFIDENTIAL

equipment is known equivalent to this equipment. With the lack of barometric pressure measurement, it appears to be specialized in function. The simple remote indication of all four parameters give the Soviet equipment a feature not found in U. S. equipment.

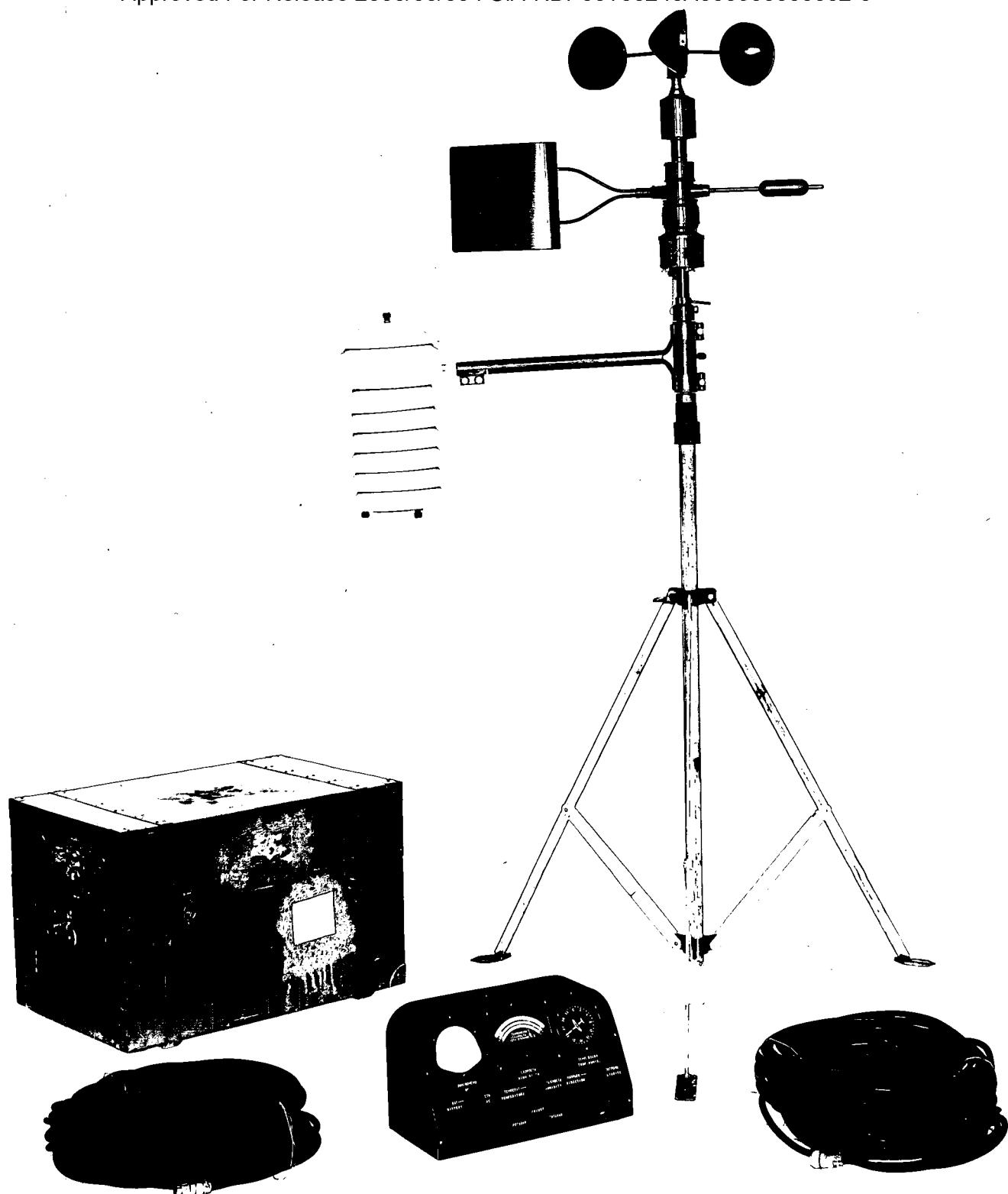
a. Design of the equipment tends toward sturdiness and simplicity of assembly and operation, and not toward refinement in technique of measurement. The accuracies of the Soviet equipment are not as good as what can be obtained by separate U. S. equipments to perform the measurements individually. No new technique of measurement is used by the Soviet equipment, and no new sensors. Its usefulness to anyone interested in portable equipment for measuring meteorological parameters lies in the study of the construction of the equipment and the method of obtaining simple remote indication of the parameters.

inclusion

Photograph of Soviet Remote-Reading Meteorological Station, Type DRS-II-53

CONFIDENTIAL

Approved For Release 2008/06/06 : CIA-RDP80T00246A000500080002-6



"FOREIGN SIGNAL EQUIPMENT" (SOVIET) MCN-17911
REMOTE READING METEOROLOGICAL STATION, TYPE DMS-N-53
OVERALL VIEW . SHOWING EQUIPMENT ERECTED

DOWNGRADED AT 12 YEAR INTERVALS NOT AUTOMATICALLY DECLASSIFIED DOD DIR 5200.10

Approved For Release 2008/06/06 : CIA-RDP80T00246A000500080002-6

~~CONFIDENTIAL~~

CONFIDENTIAL